"Faster, Better, Cheaper" - Benefits of Internet Protocols in Space

Ron Parise

Keith Hogie, Ed Criscuolo, Jim Langston

Computer Sciences Corp. (CSC)

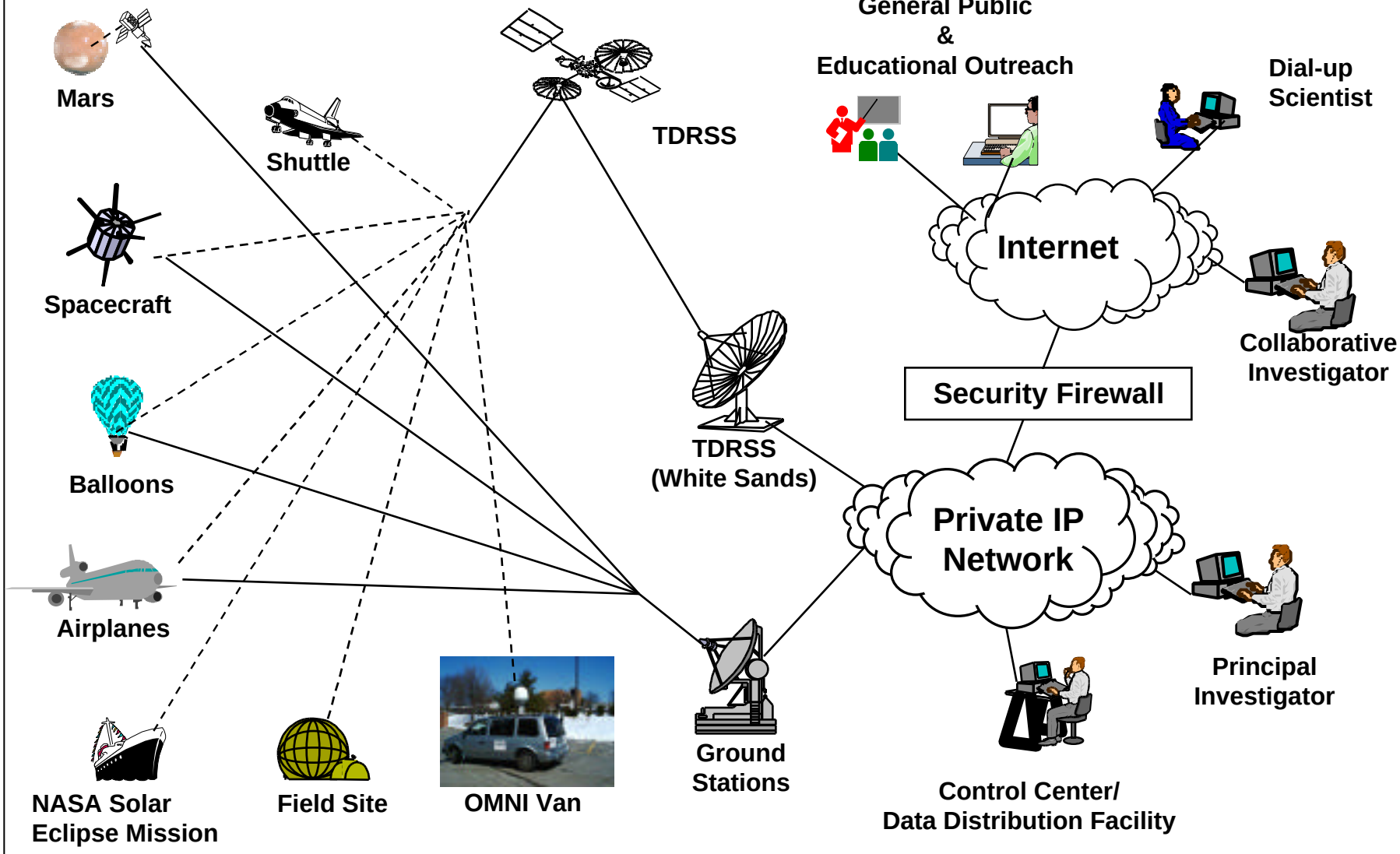
“Unique to Space”

- **Intermittent Connectivity**
- **Noisy Links**
- **Dynamic Network Topology**
- **Asymmetric data rates**
- **Potentially Large Bandwidth-Delay Product**

The New Face of Telecommunications

- **Internet Ready Cell Phones, PDA's, Wireless Modems**
  - Intermittent Connectivity (Mail Servers)
  - Noisy Links (FEC)
  - Dynamic Network Topology (Mobile IP)
- **DSL/Cable modems**
  - Asymmetric data rates (UDP based file transfer)
  - Noisy Links
- **Gigabit/s WAN**
  - Large bandwidth-delay product (UDP based file transfer)

Standard IP Communication Concept



Why IP on the Space-to-ground Link?

Where are the benefits?

- **Mission Design**
- **Software development**
- **Hardware Development**
- **Testing and Integration**
- **Flight Operations**

Mission Design

- **Economically enables complex mission requirements**
  - Multi-sensor missions (Sensorweb)
  - Inter-spacecraft collaboration
  - Formation flying communications
- **Minimizes large complex Interface Control Documents**

Software Design

- **Standard IP sockets interface for programmers**
  - Minimal learning curve for new flight software programmers
  - Standard applications easily ported to flight environment
  - Software development does not require specialized hardware and software to test applications.

Hardware Development

- **No need for specialized interface simulators for subsystem development**
  - Use standard network interfaces (Ethernet, 1394, Serial (HDLC))
- **On-board LAN technology enables distributed testing during development.**

Integration and Test

- **Pre-Integration testing over the Internet**
  - Allow subsystems to communicate with each other prior to shipment to integration site.
  - Problems identified and resolved very early at the subsystem manufacturing facility.
  - Minimize special simulators required during hardware development
- **Actual integration activities proceeds more smoothly saving both time and money.**

Mission Operations

- **Use the same software as laboratory testing**
  - Since the interface is the same in flight as during instrument development, new software is not required.
- **New commercial developments can be taken advantage of after launch.**
- **New collaborations between existing spacecraft or other instruments can be implemented simply.**
- **Data distribution to new, mobile or geographically distributed flight ops teams and investigators can be configured quickly and easily.**

Security

- **Authentication of data source**
  - VPN technology available for most platforms
- **Encryption of commands and data**
  - Secure shell also available for most platforms
- **Private physical network**
- **Many commercial solutions available that use some or all of these capabilities.**